Space Weather Technical Forecast

Issued on Sunday, 02 January 2022 at 12:48 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor storm on 02 January. Slight chance of moderate solar activity throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was low, with two C-class flares from AR2918, the largest of which was a C2.3 at 01/1909 UTC. There are three sunspots on the disc. AR2918 (Bxo/Beta) which is the most active, as fluctuated between a bi-polar region and fading to plage, but still contains a significant level of magnetic flux. This region is about to rotate off the visible disk but will retain its flare risk for 24 hours or so. AR2916 (Dao/Beta) is the largest region, but has been relatively inactive, with small changes in the appearance of the trailer spots and low level B-class flaring. A filament eruption emanated from this region around 01/1343 UTC, but no CME was discernible on coronagraph imagery. The remaining sunspot region, AR2922 (Cro/Beta), appears to be stable, with no significant activity.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, have been elevated through the period as the Earth connected with the high speed stream from coronal hole 40. Winds have generally been between 520 and 550 km/s, though highs around 600 km/s have been measured. Density has mostly been above average, reaching a peak around 18 ppcc. Total magnetic field strength started moderate, with a peak of 9 nT at 01/1200 UTC, but for most of the period has been weak below 8 nT. The north-south component, Bz varied weakly, with a negative peak of -7 nT at 01/1648 UTC and a positive peak of +5 nT at 02/0301 UTC. The Phi angle has been positive (away from the Sun) throughout. Geomagnetic activity has been Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2MeV) has been background or moderate levels. Electron fluence was well below the Active threshold at 3.99e6 integrated pfu at 01/2359 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Mainly low solar activity is forecast, with a slight chance of moderate solar activity, due mainly to regions AR2916 and AR2918.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast. The high speed stream from coronal hole 40 is expected to continue to average around 500-600 km/s through 02 January, but then decline during 03 and 04 January to background levels. Geomagnetic activity is expected to be mainly Unsettled through 02 and 03 January, with a chance of Active intervals and a slight chance of G1/Minor storms. Mainly Quiet to Unsettled conditions are then expected through 04 and 05 January as the high speed stream declines.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels, albeit with a very slight chance of S1 due to the potential contained within the two most significant sunspot regions. High energy electron flux is expected to be at background to moderate levels through 02 and 03 January, with an increasing chance of exceeding the high (1e3pfu) threshold on 04 and 05 January. Electron fluence is forecast to remain well below the Active (1e8 integrated pfu) threshold, but with an increasing trend later in the period.

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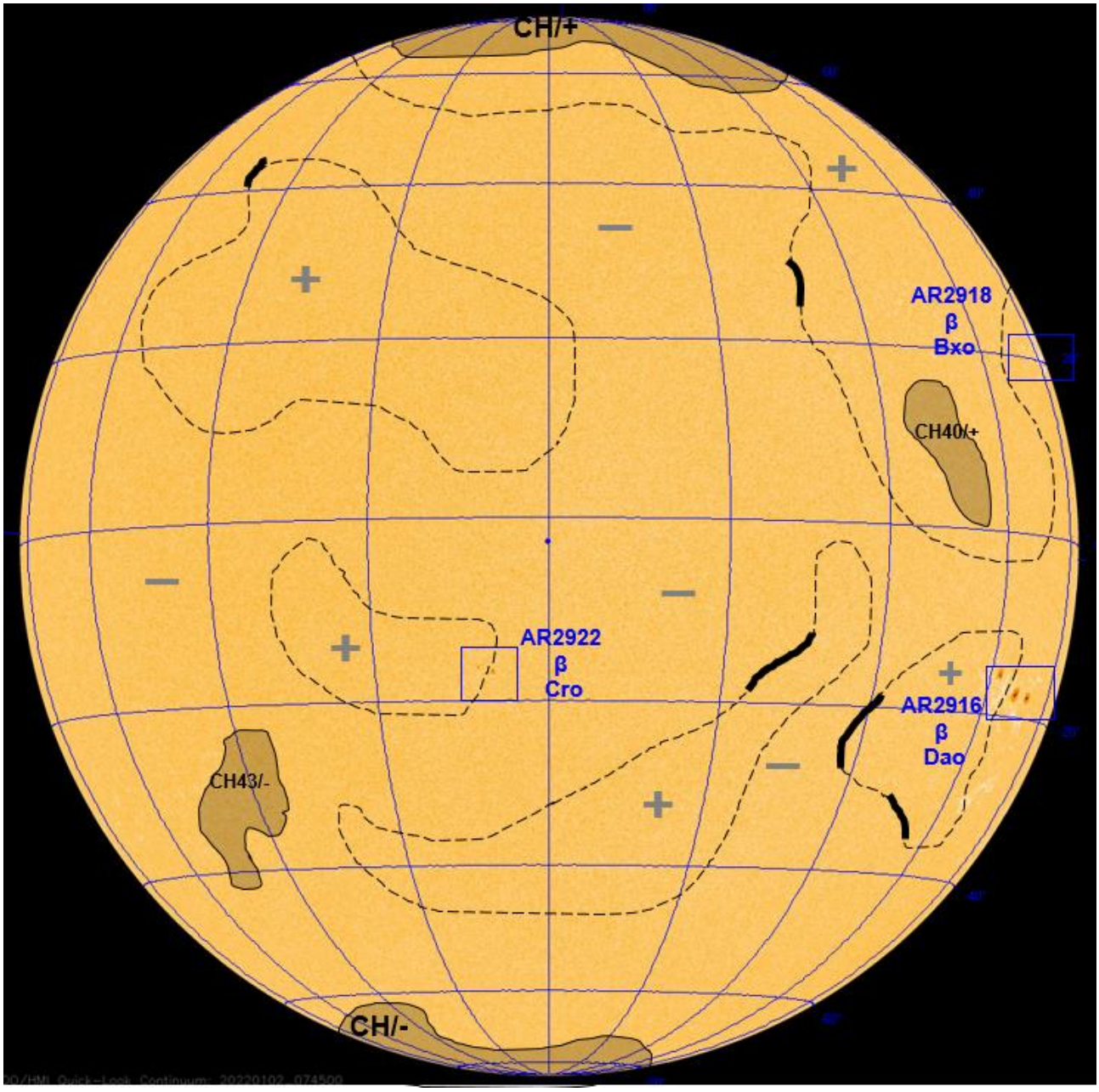
Figure 1. Solar Analysis Valid 02/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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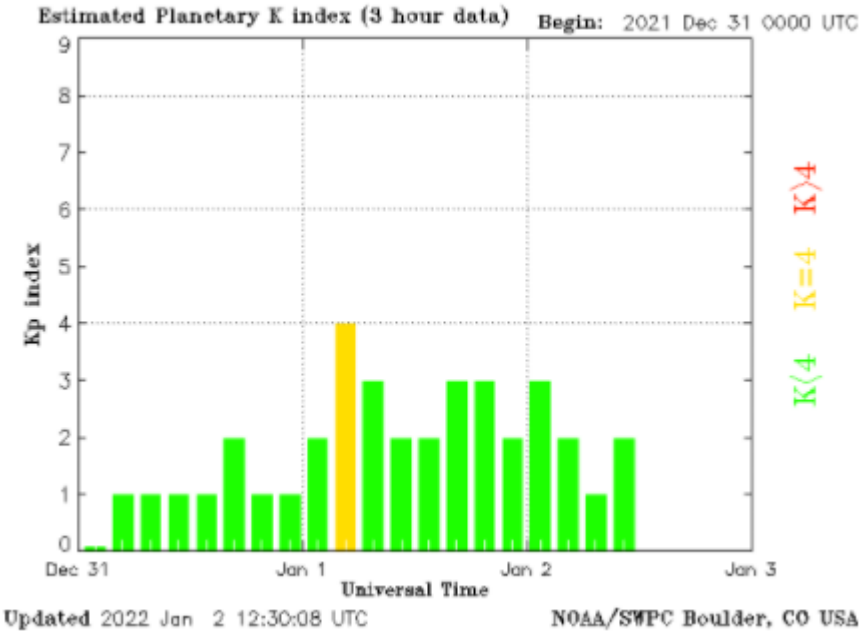
Geomagnetic Storms:

No Earth-directed CMEs are forecast.
The high speeds stream from coronal hole 40 is expected to average around 500-600 km/s through 02 January, with a decline then forecast during 03 and 04 January.
Geomagnetic activity is expected to be mainly Unsettled through 02 and 03 January, with a chance of Active intervals in any sustained periods of negative Bz, along with a slight chance of G1/Minor storms. Mainly Quiet to Unsettled conditions are then expected through 04 and 05 January as the high speed stream declines.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: NOAA SWPC Kp index



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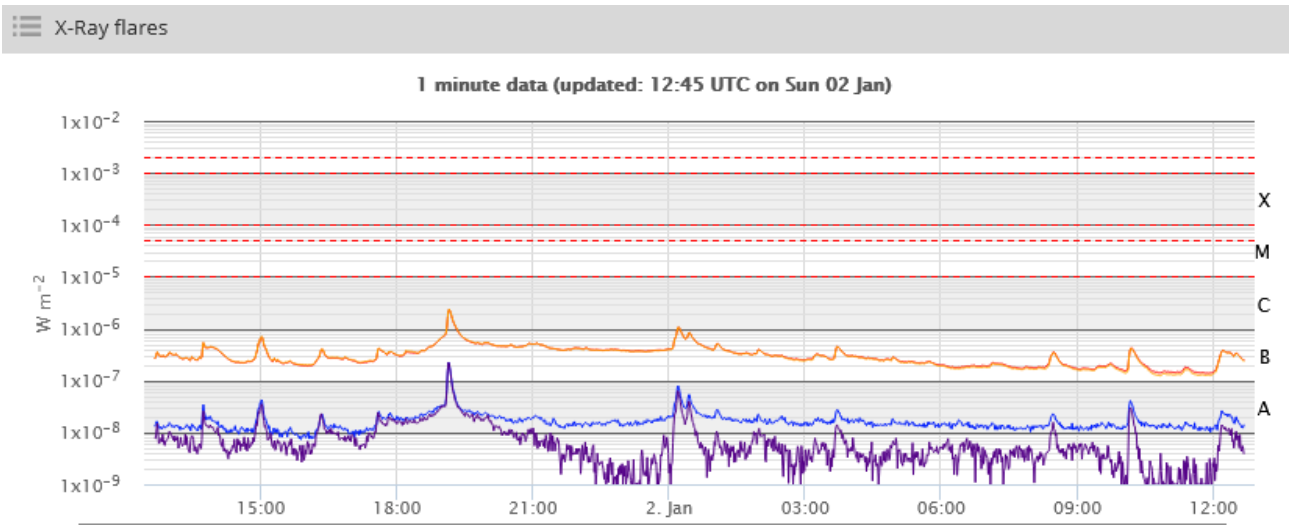
Radio Blackouts - X-Ray Flares:

Solar activity is expected to be low through the next four days.
AR2918 (Bxo/Beta) has been the most active region over the last 48 hours, with a large amount of magnetic flux contained in the region despite the rather simple visible and magnetic appearance. This region will rotate across the western horizon on 02 January, though its flare risk will continue through to 03 January. AR2916 (Dao/Beta) is a mature region in the southwest, which despite being large and carrying a large flare risk, has shown very little recent activity. An evolution of the trailer spots through the last 24 hours, suggests that there is still a risk of further activity. This region will be on the visible disc through the next three days, with a small risk of M-class flares through the period.
The other sunspot on the disc, AR2922, is benign and stable.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	10	10	5
Very Active	R3 to R5 X Class	No	3	1	1	1

Figure 3: GOES16 X-Ray flares



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist as such. Despite the apparent stability, 2916 and 2918 continue to be monitored for potential radiation storms.

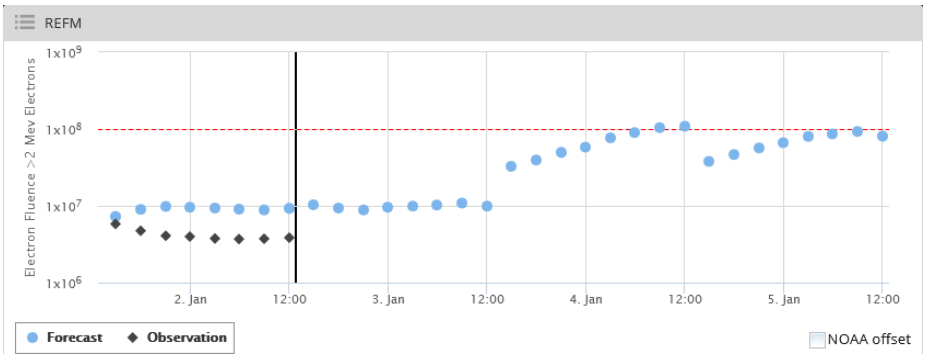
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is expected to remain at moderate or background levels through 02 January due to the geomagnetic enhancements caused by the high speed stream. Given that the high speed stream is strong, the radiation belts are likely to be distorted, so the GOES16 spacecraft may not be sampling the greatest concentration of electrons on 02 and 03 January. As the solar wind eases through 04 and 05 January, the electron flux is likely to increase as the radiation belts relax into the standard position, with an increasing risk of reaching the high (1e3pfu) threshold.
Electron fluence is expected to remain below the Active threshold, but with a rising trend through 04 and 05 January as the electron flux increases.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REF Model forecasting a steady increase in fluence, though the likelihood of 1e8 integrated pfu threshold being breached is considered small.



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